ALARM

Hardware Reliability Measurement System General Information Manual

Program Product

IBM 360-370-303X-43XX
MVS-VS1-SVS-MVT-MFT
VM/CMS-DOS/VS

[redacted]

Johnson Systems, inc.

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Hardware Reliability Measurement System General Information Manual

INTRODUCTION

Hardware failures occur every day. Disks and tapes fail regularly, sometimes several times a day. Frequently, failures are automatically recovered. But it consumes the use of expensive computer resources resulting in system degradation. And when a hard (permanent) failure occurs there is real trouble. System crashes. Equipment downtime. Abended jobs. Data loss. Then the system must be reloaded, files rebuilt, and lost jobs rerun. All very time consuming — and all very expensive.

Unfortunately, nearly all data centers and their managers have felt powerless to do anything about the problem. "Let the CE take care of it" has been the prevailing attitude.

But now, something *can* be done: ALARM — HARDWARE RELIABILITY MEASUREMENT SYSTEM. It does a lot more than measure reliability. ALARM manages vendor hardware maintenance. ALARM controls inhouse media maintenance. ALARM enhances the performance of a data center and dramatically reduces system downtime caused by hardware and media failures.

July 1980

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QUESTIONS ALARM ADDRESSES

ALARM can help the DP manager answer a variety of questions.

VENDOR MAINTENANCE

- Is the maintenance dollar well spent?
- How can the hardware vendor's responsiveness be improved?
- How can maintenance be concentrated where it is needed most?
- What statistics support the data center's contentions in data center/vendor meetings?
- Does preventive maintenance cause more problems than it solves?

RELIABILITY

- How reliable is the equipment?
- Is the equipment less reliable than similar equipment in other data centers?
- What is the effect of temporary failures on the system?
- Is the equipment performing better or worse than last year?
- Which vendor has the most reliable equipment?
- What devices are failing and why?

OPERATING IMPROVEMENTS

- Are critical data sets on the most reliable devices?
- Which tape volumes should be replaced to avoid losing an important production job?
- Which jobs are using error-prone media?
- How often and when should tape drives be cleaned?
- Which device is sending out warnings that it is about to go out of service?

4 FEATURES AND BENEFITS

REALTIME WARNING OF IMPENDING FAILURE	Allows operator to take corrective action before failures cause a system crash, thus reducing downtime. (OS sites only.)
FAILURE AND USAGE HISTORY DATA FOR *ALL* DEVICES	Provide a complete profile of data center failure problems. DP managers can then manage maintenance for all equipment.
FAILURE AND USAGE HISTORY DATA FOR MEDIA	Control media failures (tapes, disks and mass storage) by 'weeding out' bad volumes. Reduce job failures, reruns, and user dissatisfaction.
IPL REPORTING	Gives the DP manager a quick overview of all IPL's and system downtime — important management information.
INDUSTRY COMPARATIVE REPORTING	Provides comparative reliability data on plug-compatible equipment. Evaluates quality of maintenance compared to other data centers.
DATA INTEGRITY AND ACCURACY	Provide a conceptually accurate system by use of manual overrides, mean-time-to-failure measure of reliability and *all* device and media reporting.

FLEXIBLE ERROR DEFINITIONS

Insure that common failures are uniformly identified and treated. Pinpoint the problem and its cause, thereby reducing the time needed to put the equipment back in service. Optimize maintenance efforts and reduce maintenance costs.

HISTORICAL COMPARISONS

Allow the DP manager and maintenance personnel to place current failures in perspective with long-term norms.

THRESHOLD BASED EXCEPTION REPORTING

Reduces output significantly to allow the user to concentrate on the worst case devices and media. Identifies specific volumes that are error prone. Facilitates predictive maintenance.

ACCURATE RELIABILITY MEASUREMENT

Eliminates media and environmentally caused failures to accurately reflect hardware performance and quality of the maintenance service.

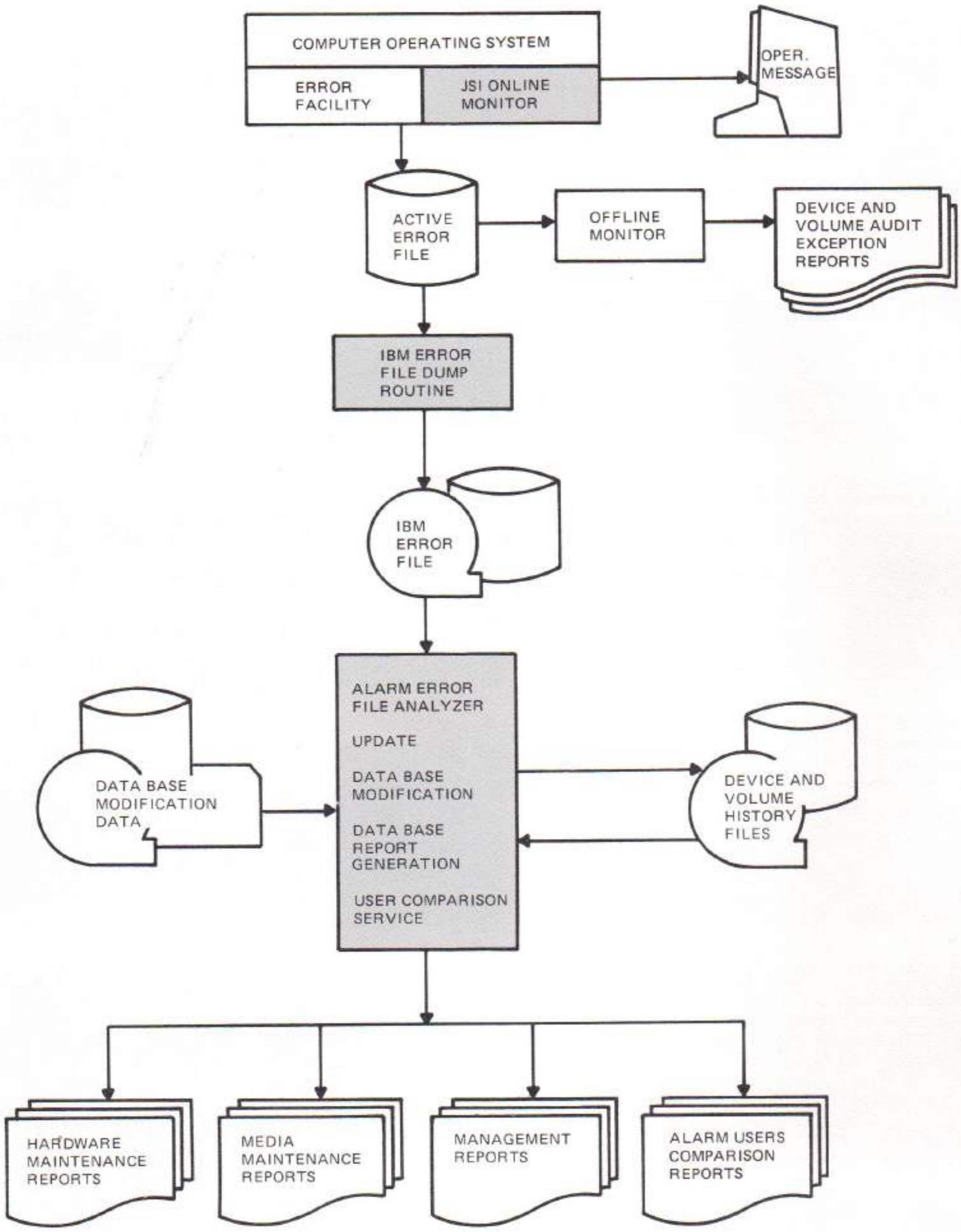
FLEXIBLE REPORT GENERATION

Provides the data you need when you need it. Generates exception reports based on failure thresholds, failure trends, and usage. Also provides reports based on time period and device selection.

USER EXIT INTERFACE

Enables data centers to customize the product to meet their own unique requirements.

6 GENERAL SYSTEM FLOW



HARDWARE MAINTENANCE REPORTS

- IPL History
- Device Maintenance
- Failure Bias Report For All Devices
- Device History
- Device I/O Error Audit

MEDIA MAINTENANCE REPORTS

- Volume Maintenance
- Failure Bias Report for Tape Volumes
- Volume History
- Volume I/O Error Audit
- Disk Error Track
- Failure and Activity Time Analysis
- Inventory Control
- Media Audit

MANAGEMENT REPORTS

- Error Summary Report by Device Type
- Device Error and Activity Summary
- Comparative Device Reliability
- Device Class Summary

ALARM USERS COMPARISON REPORTS

- ALARM Users Comparison
- ALARM Users Comparison Detail
- ALARM Vendors Comparison

SYSTEM COMPONENTS 7

The principal components of ALARM include:

- Online Monitor
- Offline Monitor
- Maintenance Reports
- Data Base Report Generator
- User Comparison Service
- Error File Analyzer
- Historical Data Files
- Data Base Modification

ONLINE MONITOR

Provides timely warnings of system degradation and potential hardware failures.

Results in low overhead — only invoked when a record is written to the Error File.

Driven by failure rate thresholds.

Reduces occurrence of permanent failures. (OS sites only.)

OFFLINE MONITOR

Simulates online monitor.

Reads active Error File and generates timely exception reports.

Determines whether warning messages were missed by the operator.

Determines activity level on console.

Determines extent of Online Monitor overhead.

MAINTENANCE REPORTS

Provide data for management and technicians.

Reduce output significantly through exception reporting.

Control inhouse media maintenance and vendor hardware maintenance.

DATA BASE REPORT GENERATOR

Provides long-term history of failure and usage trends for volumes and devices on a specified basis.

Produces reports on demand — not limited to end of the month.

Produces history and reliability reports.

USER COMPARISON SERVICE

Provides comparative reliability data on plug-compatible hardware of various vendors.

Determines the reliability of hardware and maintenance service.

ERROR FILE ANALYZER

Provides interpretive function of error data in the Error File.

Specifies up to one hundred Error Definition Statements for each device. (JSI supplies primary set of Error Definition Statements.)

HISTORICAL DATA FILES

Collect Historical information for *all* hardware and *all* volumes.

Include long-term, mid-term, and short-term counts of failures and usage.

DATA BASE MODIFICATION

Insures data integrity through manual override capability.

Corrects Error File inaccuracies.

8 SYSTEM OVERVIEW

The appropriate Error File (SYS1.LOGREC for OS users, SYSREC for DOS/VS users, and Recording Cylinders for VM users) is the primary source of input to ALARM. When this data is processed, daily technician and management maintenance reports are produced as the usage and failure data is accumulated into ongoing ALARM history files. ALARM automatically compartmentalizes the historical data by specific days, months, and long-term accumulations.

Extensive data editing is done during the update process to assure data integrity and accuracy. Several fields of the Error File records are checked for logical and format errors. A test is made to see if the records have been processed in a previous update. Any record processed previously or found to be in error is bypassed, counted, and optionally listed for additional analysis.

ALARM uses a set of Error Definition Statements for each type of device in order to:

- define the source-bit pattern of the errors
- specify error threshold levels that force reporting a given type of error in the maintenance reports
- specify whether this error definition is to be associated with the hardware or media report
- indicate what maintenance is to be performed when the failure threshold is exceeded.

Each device can accommodate up to one hundred Error Definition Statements. JSI provides an initial set of statements that can be supplemented by each data center if desired.

ALARM maintains two continuous history files — the Device History File (DHF) and the Volume History File (VHF). The DHF contains a record for each device in the system. Data on separate CPU's may be integrated or kept separately. Each DHF record contains fifteen sets of accumulators: one set for each of the last fourteen days and one installation-to-date (historical) accumulator set.

These are maintained for every error definition for each device. In addition, four monthly counter sets are maintained for accumulated permanent and temporary failures.

All of the same information described above is also maintained for usage data.

The VHF contains one record for each volume processed by the system. Each VHF record contains failure and activity data partitioned into fifteen sets of accumulators: one for each of the last fourteen months or uses of the volume, plus the long-term historical counter. Monthly accumulators for the previous four months are also maintained for usage and failures.

On a monthly basis, or whenever desired, a series of management reports can be requested that list selected information from these two files. These reports show mid-term and long-term trends to determine how well the equipment and maintenance service is reacting to implementation of data center standards. Control cards specify the time period, media, device class, or devices that are to be included.

The ALARM routines that perform threshold tests have been written for OS users so that a copy may be linked into the operating system (LINKLIB OR LPALIB) and function as a realtime, Online Monitor that produces console messages. It can be turned on and off by operator command and can monitor any subset of devices and any specific type of errors desired. Text to be sent to the operator can be customized without software changes. One potential use of the Online Monitor is to direct tape drive cleaning based on detection of increasing error rates.

All users are provided routines to simulate the Online Monitor. They read the active Error File whenever desired and produce the messages that would have been generated by the Online Monitor. This is useful to: 1) determine if any warning messages were missed by the operator; 2) determine CPU utilization of the Online Monitor; or 3) be used in lieu of the Online Monitor.

The system will produce a small tape file containing three-months cumulative data on the performance of each hardware class for each vendor. When all of the data tapes have been received by JSI, reports are generated comparing vendors and similar equipment at different installations. These ALARM User Comparative Reports are then distributed to all participating users.

10 DESIGN CONSIDERATION AND CONCEPTS

Current economic conditions demand that data center management consider carefully what software products they invest in. ALARM was designed to meet an exacting set of operational requirements. These design considerations provide an excellent guide for evaluating any hardware reliability measurement and vendor maintenance accountability system. The system should:

- Support all equipment including TP, consoles, etc.
- Provide a realtime hardware and media failure warning feature
- Measure hardware caused failures only and not those caused by the environment
- Provide a consistent measure comparing *all* computer equipment: mean-time-to-failure
- Record all temporary failures
- Provide a user exit interface for system customization
- Maintain failure and usage records for all disk, tape, and mass storage volumes
- Have a flexible report generation capability
- Provide for exception, time period, and device selection reporting
- Have a data base modification capability
- Have flexible error definitions
- Maintain a failure and usage history record for all devices in comparable terms

These factors and more form the underpinnings for the development of ALARM. To better understand how JSI addressed these guidelines, the following section lists these considerations as a series of positive "to do" statements followed by design logic.

Economy, proficiency, maintenance, and control

To obtain an immediate and significant return on the user's investment

Improving the performance of computer hardware is a frequently overlooked data center cost control factor. Reruns due to hardware induced errors, actual downtime, and unseen system degradation are all cost consuming parts of any system. Through an effective program of hardware maintenance, these problems can be held to a minimum. And . . . your system will experience an immediate utilization investment return.

Under some operations, ALARM can actually save the purchase cost every single month after only a few weeks of operation. That's significant.

To increase CE proficiency

The cost of equipment maintenance as a percentage of equipment purchase price is climbing. Rapidly. It may well double in the next five years. Simultaneously, the level of maintenance service is falling — primarily due to the lack of trained, experienced personnel. As the installed base of equipment expands, there simply are not enough skilled CE's to go around. The result? You guessed it. Lots of equipment downtime resulting in costly recoveries, costly reruns, and costly data base reconstruction.

To control inhouse maintenance standards and vendor maintenance service

Until ALARM, the DP Manager has been relatively powerless to reduce such problems. ALARM gives him an effective tool to manage inhouse maintenance standards and control vendor maintenance in such a way that improved system performance is virtually guaranteed.

To control failures induced by the data center environment.

ALARM assures the maximum availability, reliability and performance of the computer hardware and media by controlling equipment and media failures induced by the data center environment. ALARM monitors the quantity and quality of the maintenance service and controls its execution. ALARM can be used to establish maintenance goals for hardware and media, then monitor equipment utilization and failure incidents to assure that appropriate action is taken to meet these goals.

Without ALARM — forget it. Without ALARM, it is simply impossible for data center management to get involved in reliability. There isn't another product available that even comes close to offering the essential features that ALARM provides.

Permanent and temporary failures

To report permanent and temporary failures on *all* devices and media.

Permanent and temporary failures are recorded on the Error File for all hardware components in the data center. ALARM reports and maintains failure and usage data on all of these components. An IBM permanent failure is recorded on the Error File whenever an error recovery routine has exhausted its retry procedure. The number of retries, logged as temporary failures, varies according to the type of error and type of device.

To measure hardware reliability excluding environmental factors.

It is important to recognize that such failures may be due to media defects, improper hardware handling, power fluctuations, or a number of other environment factors and do not necessarily imply that the hardware requires repair. ALARM defines permanent failures as hardware requiring maintenance action so that a true measurement of *hardware* and *maintenance* reliability can be obtained.

To provide data base modification capability.

Because a data base modification capability has been provided, data center induced failures are not attributed to hardware in the ALARM system. This feature is also used to correct unrecorded system failure counts.

To provide meaningful measurement of reliability.

ALARM minimizes distorting equipment reliability measurement. Only the first permanent failure indicates repair requirement. Additional failures are generated because of continued equipment use — an operational prerogative — and certainly shouldn't be used for measuring reliability. However, these additional failures are recorded by ALARM for the purpose of providing total permanent failure patterns. ALARM's definition of permanent failure is more meaningful in evaluating maintenance service or equipment reliability.

To record all temporary failures.

Temporary failures provide a measure of system degradation introduced by error recovery procedures when hardware fails. ALARM counts *all* temporary failures, not just those interrupting the operating system.

To maintain complete and comprehensive data in history files.

The importance of maintaining sufficient short-term, mid-term and long-term data cannot be over emphasized. The ALARM history files contain short-term data for the previous fourteen days (or uses in the case of media), mid-term data for the previous four months, and long-term data recorded by an installation-to-date counter. Maintaining any less data would lead to erroneous reliability measurements and would be insufficient for predictive or preventive maintenance.

Measuring reliability

To provide reliability statistics that emphasize mean-time-to-failure but also include usage-to-failure data.

The use of repetitive failure counts as a measure of hardware reliability would only be meaningful if all hardware were used equally and in the same manner. Since this is not the case, there remain only two reasonable alternative methods of measuring hardware and maintenance reliability: 1) amount of activity to failure; and 2) amount of time to failure. Traditionally, the former method has been used.

For disk drives, for example, it has been the number of seeks per failure; for tapes, the number of start I/O's per failure. However, *a high level of hardware usage should only indicate a higher required level of maintenance service.* If timely predictive or preventive maintenance is performed, amount of I/O will not cause hardware failures. Therefore the amount of time to failure — or mean-time-to-failure (MTTF) — is a far superior means of determining hardware and maintenance reliability.

To measure reliability using a common basis for all hardware.

Using MTTF has several other advantages. It is easy to understand and already in common use for measuring reliability in the electronics industry. It provides a common basis for all computer hardware. Finally, it does not bias hardware or maintenance reliability statistics.

For those who insist on the more traditional usage-to-failure measurement, ALARM provides that calculation as well. But don't be surprised to learn that the devices shown to fail most frequently are often the ones least used.

To provide flexibility in report generation.

ALARM provides an extremely flexible report generation capability. Reliability measurements are provided whenever desired — not just at update time or end of month. Exception reporting is based on threshold counts or statistical trend analysis. Time period and device selection criteria also satisfy specific reporting needs.

Predictive and preventive maintenance

A few years ago, the preventive approach was the accepted method of hardware maintenance. Devices were turned over to the CE's for maintenance at regularly specified intervals. This approach is still regularly practiced by many data centers today. However, preventive maintenance should be, but seldom is, performed on the basis of need established by hardware usage and failure trends.

To summarize and report precise and comprehensive failure definitions.

Currently, the emphasis is on predictive rather than preventive maintenance. Using this approach, the CE analyzes Error File data to determine whether a failure pattern appears for a given device. ALARM defines and reports up to one hundred precise failure definitions for each device thereby relieving the CE of this laborious task.

Each combination of error sense data that makes up a failure pattern and affects required equipment maintenance has been defined by highly qualified vendor maintenance personnel. Common types of hardware failure can be identified, along with the maintenance action required to correct the problem.

To view all thresholds within fixed time periods.

ALARM therefore maximizes the proficiency of maintenance personnel and allows CE's with relatively little experience to function efficiently and effectively. Error definitions are associated with threshold counts which are used to indicate the number of such failures that must occur in order to trigger a maintenance activity. All thresholds are viewed within fixed time periods.

To enhance predictive maintenance through the use of an Online Monitor.

Through the use of its Online Monitor, ALARM enhances predictive maintenance. ALARM's warning feature flags hardware experiencing excessive temporary failures at the moment of occurrence. Corrective action can be taken before permanent failure takes place thereby reducing system downtime significantly. Currently, the Online Monitor is available to OS sites only.

14 REPORTS

ALARM can produce several classes of reports. However, for illustrative purposes, they are organized in functional areas of:

- Hardware maintenance
- Media maintenance
- Management

Usually maintenance reports are produced daily during history file update, and management reports are produced from the updated history files. However, it should be noted that many of the reports can be produced at update time or on demand. In addition, two of the maintenance reports are produced by the Offline Monitor.

HARDWARE MAINTENANCE REPORTS

These reports provide sufficient information to control hardware maintenance activity. However, extensive use is made of exception reporting to limit output and to concentrate maintenance where the problems are the greatest. Normally, these reports are produced when the current Error File is processed — during update of the history files. If the failure threshold provided on the Error Definition Statements is reached, the error data for the problem device is reported alongside appropriate history information. The Hardware Maintenance Reports include:

- IPL History Report
- Device Maintenance Report
- Failure Bias Report For All Devices
- Device History Report
- Device I/O Error Audit Report

IPL History Report

This report lists any IPL's which occurred during the update cycle. In multi-CPU centers, each CPU is grouped and listed in CPU serial sequence. The time gap between the time of the IPL and the last entry prior to the IPL is the estimated downtime and is maintained in the history files, along with the elapsed time of the cycle. Both times are used in the MTTF calculation seen on other reports.

1 The downtime estimate in hours and minutes is derived as the difference between the IPL time and time stamp of the previous record.

2 The Error File record type of the previous record prior to IPL.

3 The possible cause is based on the nature of this previous record.

4 Space for shift supervisor comments for those data centers maintaining a permanent daily downtime notebook.

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IPL HISTORY RE 01/15/80

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CPU SERIAL	1 DOWN TIME HH.MM	IPL MM/DD/YY HH.MM.SS	LAST LOGREC RECORD MM/DD/YY HH.MM.SS	2 RECORD TYPE	POSSIBLE CAUSE FOR SYSTEM FAILURE	3	4 COMMENTS
XXXXXX	.09	01/15/80 01.08.13	01/15/80 00.59.25	MDR	NO OPINION		
XXXXXX	1.59	01/15/80 07.02.09	01/15/80 05.03.33	MIH	DEVICE END PENDING		
XXXXXX	.04	01/15/80 13.27.08	01/15/80 13.23.06	MCH	CPU OR CORE FAILURE		
CPU TOTAL	2.12						

Device Maintenance Report

This exception report lists the specific devices whose error occurrence exceed the specified threshold of acceptance. Its primary audience is maintenance personnel and therefore breaks and page ejects on change in vendor. This is a very useful report to control day-to-day maintenance activity.

1 Total number of times since tracking this device that this type of error has had its threshold value exceeded.

2 Maintenance Code is intended for use by the data center to indicate the probable maintenance action that should be taken to correct the problem.

3 If specified on the Error Definition Card, a statistical subroutine is executed that back-checks the last 14 days to check for failure patterns.

4 A work space area that can be used by the CE to show data center personnel that appropriate maintenance action has been performed.

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DEVICE MAINTENANCE REPORT
VENDOR NAME IBM

ERROR DESCRIPTION	DEVICE TYPE	UNIT ADDRESS	TIMES EXCEEDED	THRESHOLD VALUE	ERROR COUNT	THRESHOLD DATE	MAINTNCE CODE	CPU SERIAL	DATE FIXED	REPAIR TIME	COMMENTS
TEMP R/W ERRORS	1403	40E	68	5	167	01/15/80	A01	XXXXXX			
PERM R/W ERRORS	1403	40E	63	1	1	01/15/80	A02	XXXXXX			
TEMP R/W ERRORS	1403	40E	53	5	49	01/15/80	A01	XXXXXX			
PERM R/W ERRORS	3277	477	86	1	7	01/15/80	A02	XXXXXX			
DATA CHECK	3350	1C0	18	1	2	01/15/80	A06	XXXXXX			
TEMP R/W ERRORS	3420	6C1(8C1)	374	5	23	01/15/80	A01	XXXXXX			
TEMP R/W ERRORS	3420	6C2(8C2)	386	5	53	01/15/80	A01	XXXXXX			
TEMP R/W ERRORS	3420	6C3(8C3)	405	5	26	01/15/80	A01	XXXXXX			
PERM R/W ERRORS	3420	6C4	90	1	1	01/15/80	A02	XXXXXX			
TEMP R/W ERRORS	3420	6C4	357	5	122	01/15/80	A01	XXXXXX			
PERM R/W ERRORS	3420	6C5	98	1	2	01/15/80	A02	XXXXXX			
TEMP R/W ERRORS	3420	6C5	373	5	359	01/15/80	A01	XXXXXX			
TEMP R/W ERRORS	3420	6C9	366	5	35	01/15/80	A01	XXXXXX			
TEMP R/W ERRORS	3420	6CA	390	5	20	01/15/80	A01	XXXXXX			
TEMP R/W ERRORS	3420	6CB	383	5	29	01/15/80	A01	XXXXXX			
TEMP R/W ERRORS	3420	6CC(8CC)	365	5	10	01/15/80	A01	XXXXXX			
TEMP R/W ERRORS	3420	6CD	366	5	23	01/15/80	A01	XXXXXX			
PERM R/W ERRORS	3800	A18	631	1	8	01/15/80	A02	XXXXXX			
BUS OUT CHECK	3800	A18	360	1	1	01/15/80	A04	XXXXXX			
EQUIPMENT CHECK	3800	A18	534	1	3	01/15/80	A05	XXXXXX			
PERM READ ERRORS	3800	A18	DAILY ERROR TREND OBSERVED			01/15/80	A16	XXXXXX			
TEMP WRITE ERRORS	3800	A18	DAILY ERROR TREND OBSERVED			01/15/80	A15	XXXXXX			
TEMP R/W ERRORS CHK	3800	A18	267	5	23	01/15/80	A01	XXXXXX			
FUSER STA. -2X TOT	3800	A18	150	5	6	01/15/80	TXX	XXXXXX			

Failure Bias Report For All Devices

This report lists the devices responsible for at least 80% of the total errors in descending error count sequence. There is a separate list for both permanent and temporary errors. This report can be used to assure that maintenance is concentrated where it is needed the most.

1 This report can be run from the history files for longer time periods than one day.

2 This report can be limited to device type (e.g., disk, tape).

3 Few devices generating large number of failures on a regular basis may indicate requirement for major overhaul or replacement.

4 By sorting in descending sequence, the problem devices are listed at the beginning of the report.

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FAILURE BIAS REPORT FOR ALL DEVICES

REPORT REFLECTS DATA FOR 01/15/80

11 PERCENT OF DEVICES EXPERIENCED
68 PERCENT OF PERMANENT FAILS
45 DEVICES OUT OF 390 DEVICES
137 PERM FAILS OUT OF 154 FAILS

6 PERCENT OF DEVICES EXPERIENCED
100 PERCENT OF TEMPORARY FAILS
26 DEVICES OUT OF 390 DEVICES
954 TEMP FAILS OUT OF 954 FAILS

DEV-TYPE	ADDRESS	VENDOR	PERM FAILS	DEV-TYPE	ADDRESS	VENDOR	TEMP FAILS
3270	0C5	COMTEN	14	3420	6C5	IBM	359
3270	406	COMTEN	12	1403	40E	IBM	156
3800	A18	IBM	8	3420	6C4	IBM	122
3277	477	IBM	7	3420	6C2	IBM	53
2741	06A	COMTEN	5	1403	40F	IBM	48
2741	06E	COMTEN	5	3420	6C9	IBM	35
3270	408	COMTEN	5	3420	6CB	IBM	29
2741	058	COMTEN	4	3800	A18	IBM	24
2741	086	COMTEN	4	3420	6C3	IBM	24
2741	440	COMTEN	4	3420	6C1	IBM	23
2741	440	COMTEN	4	3420	6CD	IBM	23
3270	4C8	COMTEN	4	3420	6C1	IBM	20
2741	066	COMTEN	3	3420	6CC	IBM	11
2741	089	COMTEN	3	3330-1	371	ITEL	5
3270	088	COMTEN	3	2741	4A0	COMTEN	4
3270	0C7	COMTEN	3	3330-1	251	ITEL	3
3270	4BC	COMTEN	3	3330-1	258	ITEL	3
3270	4C2	COMTEN	3	3350	1C0	IBM	2
3270	407	COMTEN	3	3330-1	253	ITEL	2

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Device History Report

This report lists those devices appearing on the Device Maintenance Report. All short-term, mid-term, and long-term failure counts in every failure category are shown along with activity counts. This report and the Volume History Report are used to determine if the failures are due to the device or with the media.

1 This report is for a specific device — in this case disk drive 37E.

2 This section shows failures and activity for last 14 days and the historical total.

3 All failures ever logged against this device are listed.

4 This section shows mid-term data for failures and activity.

5 This section shows which media volumes (in this case, which disks) have been last mounted on this device.

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DEVICE HISTORY REPORT

ADDRESS = 37E **1** UNIT = 3330-1 MOL = 00 VENDOR = ITEL CPU SERIAL = XXXXXX START DATE = 09/01/77 STATUS = ACTIVE

NUMBER OF ACTIVITY DAYS = 776 VOLUMES PROCESSED = 895 SWAPS FROM DEVICE = 01

HOURS AVAILABLE = 14,083 SEEK COUNT = 30 MILLION BYTES READ FROM DEVICE = 334 BILLION 145,496,757

*** DETAILED ERROR HISTORY *** **2**

ERROR DESCRIPTION	HIST TOTAL	01/02	01/03	01/04	01/05	01/06	01/07	01/08	01/09	01/10	01/11	01/12	01/13	01/14	01/15
LOGREC RECORD COUNT	18,746	36	27	23	22	12	52	29	17	27	23	18	24	34	29
UNIT CHECK REC COUNT	107	0	0	0	0	0	0	0	0	0	0	0	0	0	1
TEMP R/W ERRORS	1,897	0	0	2	0	1	0	1	0	1	1	0	1	0	1
ECC TEMP	5	0	0	0	0	0	0	0	0	0	0	0	0	0	1
TEMP READ ERRORS	1,897	0	0	2	0	1	0	1	0	1	1	0	1	0	1
CORRECTABLE DATA CHK	318	0	0	2	0	1	0	1	0	1	1	0	1	0	1
SEEK COUNT		356K	8,159	100K	27,506	3,170	78,881	2,896	189	28,327	21,825	9	9,952	6,431	32,839
BYTES READ		18	168M	826M	156M	209M	444M	73M	2,679K	391M	370M	109K	316M	82M	454M
NUMBER VOLUMES		0	0	0	0	0	1	3	2	0	0	0	0	0	0

3

*** DEVICE ERROR AND ACTIVITY SUMMARY *** **4**

	PERMANENT ERRORS	TEMPORARY ERRORS	SEEK COUNT	NUMBER SEEKS PER TEMP ERR	NUMBER SEEKS PER PERM ERR	VOLUME USES (MOUNTS)	BYTES READ FROM DEVICE
JANUARY	0	8	677,368	84,671	677,368	6	5,497M
DECEMBER	0	19	1,455,276	76,593	1,455,276	2	14,184M
NOVEMBER	0	19	1,255,356	66,071	1,255,356	0	14,761M
OCTOBER	0	15	1,634,421	108,961	1,634,421	0	18,101M

*** VOLUME HISTORY ON DEVICE *** **5**

VOLUME SERIAL	UNLOAD DATE	UNLOAD TIME	SEEK COUNT	TEMP R/W ERRORS	PERM R/W ERRORS
M20403	01/15/80	24.00	32,839	1	0
M20403	01/14/80	24.00	6,431	0	0
M20403	01/13/80	24.00	9,952	1	0
M20403	01/12/80	24.00	9	0	0
M20403	01/11/80	24.00	21,825	1	0
M20403	01/10/80	24.00	28,327	1	0
M20403	01/09/80	24.00	16	0	0
PRIV01	01/09/80	03.14	173	0	0
PRIV30	01/08/80	23.57	113	1	0
PRIV23	01/08/80	18.31	131	0	0
PRIV27	01/08/80	16.16	32	0	0

Device I/O Error Audit Report

This report is produced only by the Offline Monitor using data from the active Error File. It is a detailed list of all devices exceeding the predefined threshold on the Error Definition Statements. An equivalent message would have been sent to the operator's console by the Online Monitor for every device listed here if it was in operation.

1 Every device having an Error Definition Statement with the appropriate parameters specified and failure threshold reached or exceeded will be shown.

2 The volume serial number is shown for devices using volumes.

3 The number of errors shown equal or exceed the threshold count for every entry.

4 All data for the same CPU is shown in the same report.

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DEVICE I/O ERROR AUDIT REPORT
CPU SERIAL XXXXXX **4**

ERROR DESCRIPTION	DEVICE TYPE **1**	UNIT ADDRESS	VOLUME SERIAL **2**	THRESHOLD VALUE **3**	ERROR COUNT	THRESHOLD DATE	THRESHOLD TIME	MAINTNCE CODE	VENDOR NAME
DATA CHECK	1403	01E		1	1	01/16/79	16.58.42	A06	IBM
TEMP R/W ERRORS	1403	01E		5	6	01/06/79	16.58.42	A01	IBM
PERM R/W ERRORS	1403	01E		1	1	01/16/79	16.58.42	A02	IBM
DATA CHECK	1403	01E		1	1	01/16/79	16.58.42	A06	IBM
PERM R/W ERRORS	1403	01E		1	1	01/16/79	17.00.38	A02	IBM
PERM R/W ERRORS	1403	01E		1	1	01/16/79	17.00.38	A02	IBM
TEMP R/W ERRORS	1403	01E		5	5	01/16/79	17.00.38	A01	IBM
PERM R/W ERRORS	1403	01E		1	1	01/16/79	17.00.39	A02	IBM
PERM R/W ERRORS	1403	01E		1	1	01/16/79	17.00.39	A02	IBM
PERM R/W ERRORS	1403	01E		1	1	01/16/79	17.00.39	A02	IBM
PERM R/W ERRORS	1403	01E		1	1	01/16/79	17.00.39	A02	IBM
PERM R/W ERRORS	1403	01E		1	1	01/16/79	17.00.39	A02	IBM
TEMP R/W ERRORS	1403	01E		5	5	01/16/79	17.00.39	A01	IBM
PERM R/W ERRORS	1403	01E		1	1	01/16/79	17.00.39	A02	IBM
DATA CHECK	1403	01E		1	1	01/16/79	17.00.39	A06	IBM
PERM R/W ERRORS	1403	01E		1	1	01/16/79	17.00.39	A02	IBM
PERM R/W ERRORS	1403	01E		1	1	01/16/79	17.00.39	A02	IBM
DATA CHECK	1403	01E		1	1	01/16/79	17.00.39	A06	IBM
TEMP R/W ERRORS	1403	01E		5	5	01/16/79	17.00.39	A01	IBM
PERM R/W ERRORS	1403	01E		1	1	01/16/79	17.00.39	A02	IBM
PERM R/W ERRORS	1403	01E		1	1	01/16/79	17.00.40	A02	IBM
PERM R/W ERRORS	1403	01E		1	1	01/16/79	17.00.40	A02	IBM
PERM R/W ERRORS	1403	01E		1	1	01/16/79	17.00.40	A02	IBM
PERM R/W ERRORS	1403	01E		1	1	01/16/79	17.00.40	A02	IBM
TEMP R/W ERRORS	1403	01E		5	5	01/16/79	17.00.40	A01	IBM
PERM R/W ERRORS	1403	01E		1	1	01/16/79	17.00.40	A02	IBM
PERM R/W ERRORS	1403	01E		1	1	01/16/79	17.00.40	A02	IBM
DATA CHECK	1403	01E		1	1	01/16/79	17.00.40	A06	IBM
PERM R/W ERRORS	1403	01E		1	1	01/16/79	17.00.41	A02	IBM

MEDIA MAINTENANCE REPORTS

These reports are similar in nature to the Device Maintenance Reports, but are for media (disks and tapes). Nearly all of the reports are produced during the update of the history files and are used to control the day-to-day activities of inhouse maintenance personnel. One of the primary goals of this effort is to eliminate bad volumes from the library. Extensive selection capability gives media maintenance personnel a valuable tool in addressing media problems. The Media Maintenance Reports consist of the following:

- Volume Maintenance Report
- Failure Bias Report For Tape Volumes
- Volume History Report
- Volume I/O Error Audit Report
- Disk Error Track Report
- Failure And Activity Time Analysis Report
- Inventory Control Report
- Media Audit Report

Volume Maintenance Report

This report lists only those volumes which experience failures exceeding the established thresholds. The serial number of the volume is shown along with the device using the volume at the time of failure. The higher any threshold is set, the less likely the failure will be reported. Thresholds should be set such that the size of the report corresponds to the ability of the maintenance staff to follow up the errors listed within the next day. The intended result is *management directed maintenance*.

1 Every type of error defined on Error Definition Statements is captured from the Error File and maintained by ALARM. Only errors exceeding the thresholds are reported here.

2 Physical and logical address is displayed if different from one another.

3 Threshold for devices are for mount time.

4 The Job Name in the Error File is displayed if present.

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VOLUME MAINTENANCE REPORT

ERROR DESCRIPTION 1	DEVICE TYPE	UNIT ADDR	VOLUME SERIAL	THRESHOLD VALUE	ERROR COUNT	THRESHOLD DATE	THRESHOLD TIME	MAINTNCE CODE	JOB NAME	COMMENTS
TEMP READ ERRORS	3330-1	251 2	CICP02	5 3	14	01/15/80	23.59.36	A14		
TEMP READ ERRORS	3330-1	371(B71)	IPDJC1	5	5	01/15/80	23.59.37	A14	BKRIPJC1 4	
TEMP WRITE ERRORS	3420	6C1	001264	10	15	01/15/80	05.59.27	A15		
TEMP WRITE ERRORS	3420	6C2	001226	10	24	01/15/80	05.54.55	A15		
TEMP WRITE ERRORS	3420	6C2	002190	10	20	01/15/80	21.27.45	A15		
DATA CHECK	3420	6C4(BC4)	000893	1	21	01/15/80	05.17.24	A06	BKRES303	
PERM READ ERRORS	3420	6C4(BC4)	000893	1	1	01/15/80	05.17.24	A16	BKRES303	
SWAP ACTIVITY	3420	6C4	000893	1	1	01/15/80	05.17.24	A11		
TEMP WRITE ERRORS	3420	6C4	000893	10	93	01/15/80	05.34.23	A15		
TEMP WRITE ERRORS	3420	6C5	000362	10	81	01/15/80	01.01.40	A15		
TEMP WRITE ERRORS	3420	6C5(BC5)	001127	10	104	01/15/80	05.37.55	A15		
DATA CHECK	3420	6C5(BC5)	001377	1	1	01/15/80	05.58.07	A06	BKRM2041	
TEMP WRITE ERRORS	3420	6C5(BC5)	001377	10	11	01/15/80	05.58.07	A15	BKRM2041	
PERM READ ERRORS	3420	6C5(BC5)	001377	1	1	01/15/80	05.58.07	A16	BKRM2041	
SWAP ACTIVITY	3420	6C5	001377	1	1	01/15/80	05.58.07	A11		
DATA CHECK	3420	6C5	001377	1	1	01/15/80	06.06.43	A06	BKRM2041	
PERM READ ERRORS	3420	6C5	001377	1	1	01/15/80	06.06.43	A16	BKRM2041	
TEMP WRITE ERRORS	3420	6C5	001690	10	24	01/15/80	06.14.15	A15		
TEMP WRITE ERRORS	3420	6C5	001795	10	93	01/15/80	17.14.55	A15		
TEMP WRITE ERRORS	3420	6C9	000541	10	26	01/15/80	04.36.33	A15		

Failure Bias Report For Tape Volumes

This report is similar in concept to the Failure Bias Report For All Devices described earlier but for tape volumes. The tape volumes experiencing the most failures are shown at the beginning of the report. Volumes are listed on the report until 80% of the errors are accounted for. Volumes experiencing temporary and permanent errors are shown in separate lists. Inhouse media maintenance is directed to those volumes with the worst problem.

1 Report can be for any devices having mountable volumes.

2 Indicates clearly if the tape problems are limited to just a few volumes.

3 Sorting in descending sequence allows inhouse personnel to address the worst problems first.

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FAILURE BIAS REPORT FOR TAPE VOLUMES 1

1 PERCENT OF VOLUMES EXPERIENCED
100 PERCENT OF PERM FAILS
2 VOLUMES OUT OF 365 2
6 PERM FAILS OUT OF 6

4 PERCENT OF VOLUMES EXPERIENCED
80 PERCENT OF TEMP FAILS
17 VOLUMES OUT OF 365
562 TEMP FAILS OUT OF 700

VOLUME	PERM FAILS
001377	4
000893	2

VOLUME	TEMP FAILS
001127	104
000893	103
001795	93
000362	81
000541	26
001226	24
001690	24
002190	20
001377	16 3
001264	15
002053	11
000386	9
002940	9
000079	8
001461	7
000651	6
001171	6

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Volume History Report

This report is used to resolve device versus volume cause of error by showing a trace of where (which devices) a volume has experienced error when used previously. Volume histories are produced for all volumes appearing on the Volume Maintenance Report. This method of producing selected histories is intended to give error evaluation personnel a complete frame of reference in which to view daily exceptions.

1 The particular volume experiencing problems.

2 This sample report is for a disk volume. Same report is used for tape volumes.

3 The number of times since volume was put in service that it exceeded error thresholds and appeared on a maintenance report.

4 The last fourteen uses of the volume are displayed.

5 The current use which caused the volume to be listed.

6 Summary information for this volume for four months of use.

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VOLUME HISTORY REPORT

VOLUME SERIAL = LICP02 **1**   MEDIA TYPE = 3330-1 **2**   HISTORY START DATE = 07/07/77   LAST USAGE DATE = 01/15/80

TIMES USED WITH NO ERRORS = 305   TIMES USED WITH ERRORS = 301   TIMES ON MAINTENANCE REPORT = 51 **3**

SEEK COUNT = 6 MILLION 264,454   BYTES READ FROM VOLUME = 88 BILLION 458,113,911

*** DETAILED ERROR HISTORY *** **4**

ERROR DESCRIPTION	HIST TOTAL	01/02	01/03	01/04	01/05	01/06	01/07	01/08	01/09	01/10	01/11	01/12	01/13	01/14	01/15 **5**
TEMP READ ERRORS	4,893	0	1	5	0	3	0	2	1	3	2	0	2	0	14
CORRECTABLE DATA CHK	859	0	1	5	0	3	0	2	1	3	2	0	2	0	3
SEEK COUNT		4,015	2,515	6,461	0	1,141	4,674	2,708	5,781	9,500	5,526	0	1,146	4,888	4,906
BYTES READ		21M	91M	273M	22,796	164M	23M	54M	193M	301M	191M	22,516	164M	44M	183M
PHYSICAL UNIT ADDR		251	251	251	251	251	251	251	251	251	251	251	251	251	251
END USE TIME		24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00

*** VOLUME ERROR AND ACTIVITY SUMMARY ***

MONTH	PERMANENT ERRORS	TEMPORARY ERRORS	INPUT-OUTPUT SEEK COUNT	NUMBER SEEKS PER TEMP ERR	NUMBER SEEKS PER PERM ERR	TIMES ON MAINT REPORT	VOLUME USES (MOUNTS)	BYTES READ FROM DEVICE
JANUARY	0	22	53,269	2,421	53,269	2	15	1,742M
DECEMBER **6**	2	113	126,374	1,118	63,187	3	28	3,006M
NOVEMBER	0	56	103,004	1,839	103,004	0	29	2,256M
OCTOBER	1	37	99,188	2,680	99,188	1	30	2,089M

Volume I/O Error Audit Report

This report is produced by the Offline Monitor using data from the active Error File. It is a detailed list of all volumes exceeding the predefined threshold on the Error Definition Statements. An equivalent message would have been sent to the operator's console by the Online Monitor for every volume listed here if the Online Monitor was in operation.

1 Any of the errors described on the Error Description Statements can cause the volume to be listed if the threshold is reached.

2 The specific unit on which the volume resided is displayed.

3 The job name is listed if available in the Error File.

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VOLUME I/O ERROR AUDIT REPORT
CPU SERIAL XXXXXX

ERROR DESCRIPTION **1**	DEVICE TYPE	UNIT ADDRESS **2**	VOLUME SERIAL	THRESHOLD VALUE	ERROR COUNT	THRESHOLD DATE	THRESHOLD TIME	MAINTNCE CODE	JOB NAME **3**
EQUIPMENT CHECK	3420	284	JSTAPE	1	1	01/15/80	16.40.22	A06	TPDUMP1
DATA CHECK	3420	285	000342	1	1	01/15/80	16.55.44	A01	COPYTP
DATA CHECK	3420	281	005440	1	1	01/15/80	16.58.46	A02	UPDATE
EQUIPMENT CHECK	3420	181	000056	1	1	01/15/80	16.59.11	A06	JB1456
DATA CHECK	3420	187	003325	1	1	01/15/80	17.00.38	A02	TPDUMP1
DATA CHECK	3420	18F	BKUP01	1	1	01/15/80	17.05.22	A02	TPDUMP1
DATA CHECK	3420	185	TPCOPY	1	1	01/15/80	17.06.16	A01	IEBCOPY
DATA CHECK	3420	287	JS0042	1	1	01/15/80	17.26.47	A02	IEBCOPY
DATA CHECK	3420	180	JS0086	1	1	01/15/80	17.28.59	A02	COPYTP
DATA CHECK	3420	180	JS0664	1	1	01/15/80	18.22.25	A02	IEBCOPY
DATA CHECK	3420	280	JS3305	1	1	01/15/80	18.29.43	A02	IEHMOVE
DATA CHECK	3420	283	000443	1	1	01/15/80	18.36.39	A02	PUNCH
DATA CHECK	3420	284	0C9500	1	1	01/15/80	18.44.22	A01	IEBCOPY
DATA CHECK	3420	283	JS0440	1	1	01/15/80	19.00.41	A02	
EQUIPMENT CHECK	3420	183	CMCGZV	1	1	01/15/80	20.32.51	A06	
DATA CHECK	3420	284	000043	1	1	01/15/80	20.54.29	A02	
DATA CHECK	3420	18A	000056	1	1	01/15/80	20.55.18	A02	FILEBKUP
EQUIPMENT CHECK	3420	184	000332	1	1	01/15/80	20.58.57	A06	TPDUMP1
DATA CHECK	3420	285	007776	1	1	01/15/80	21.12.44	A01	
DATA CHECK	3420	287	000433	1	1	01/15/80	22.43.00	A02	
DATA CHECK	3420	289	JS0006	1	1	01/15/80	22.47.40	A02	FILEBKUP
DATA CHECK	3420	181	000634	1	1	01/15/80	23.10.13	A02	

Disk Error Track Report

This report is produced either during the update run or by the Offline Monitor. It provides a detailed list of track addresses experiencing Data Checks or Equipment Checks. This report indicates the scope of this kind of problem and provides operations personnel with sufficient data to solve the problems.

1 The appropriate Error File sense bits are tested to indicate if the error was temporary or permanent. Furthermore, if the Data Check bit is on, the word "DATA" appears in the entry; otherwise 'EQUIP' appears.

2 The data set name is determined at report run time by searching the VTOC. If the pack is not mounted, 'VOLUME NOT FOUND' is displayed.

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DISK ERROR TRACK REPORT

DEVICE	VOLSER	CCC-HH-RR	ERROR 1	ERR-CODE	TIME	DATE	CPU	UNIT	DATA SET NAME 2
3350	SHAREA	377-27-05	TEMP-DATA	1008	01.24.35	01/15/80	XXXXXX	1C0	VOLUME NOT MOUNTED
	SPOOL1	002-00-00	TEMP-EQUIP	0000	16.01.58	01/15/80	XXXXXX	1C0	VOLUME NOT MOUNTED
	SYCICS	009-24-03	TEMP-DATA	1919	01.52.46	01/15/80	XXXXXX	1C1	VOLUME NOT MOUNTED
	SYCICS	009-24-03	TEMP-DATA	1919	01.35.05	01/15/80	XXXXXX	1C1	
	SYCICS	009-24-03	TEMP-DATA	1919	02.15.21	01/15/80	XXXXXX	1C1	
	TSOPAK	121-13-05	PERM-DATA	0000	01.29.58	01/15/80	XXXXXX	1C1	VSAMDSET.T084FA00.DF079354.T8F7222
	TSOPAK	121-13-05	PERM-DATA	0000	20.24.43	01/15/80	XXXXXX	1C5(5C5)	VSAMDSET.T084FA00.DF079354.T8F7222

Failure and Activity Time Analysis Report

This report shows the distribution over day of permanent errors, temporary errors, mounts, and appropriate I/O activity recorded by the Error File. This information can be used to determine if there is a relationship between failure rates, time periods, equipment utilization, and operations personnel. Special action, such as cleaning tape drives more frequently, may be required of operations personnel.

1 Report can be for disk or tape devices.

2 Report can be for any specified time period.

3 Over half of the temporary errors and *all* of the permanent errors occurred in this four hour period. This may indicate handling problems by the graveyard shift.

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FAILURE AND ACTIVITY TIME ANALYSIS REPORT

MEDIA TYPE = 3420 1   DATA PROCESSED CONTAINED DATE RANGE FROM 01/15/80 TO 01/16/80 2

TIME RANGE	FAILURES TEMP	FAILURES PERM	ACTIVITY MOUNTS	ACTIVITY SIO	PERCENT OF TOTAL TEMP	PERCENT OF TOTAL PERM	PERCENT OF TOTAL MOUNTS	PERCENT OF TOTAL SIO
0 - 2	99	0	65	120K	14.1	0.0	12.1	11.6
2 - 4	2	0	5	6K	0.2	0.0	0.9	0.5
4 - 6	347	4	56	290K	49.5	66.6	10.4	28.0
6 - 8	55	2	23	72K	7.8	33.3	4.2	6.9
8 - 10	5	0	48	24K	0.7	0.0	8.9	2.3
10 - 12	10	0	52	89K	1.4	0.0	9.7	8.6
12 - 14	1	0	38	32K	0.1	0.0	7.0	3.0
14 - 16	1	0	50	70K	0.1	0.0	9.3	6.7
16 - 18	102	0	54	49K	14.5	0.0	10.0	4.7
18 - 20	8	0	34	45K	1.1	0.0	6.3	4.3
20 - 22	58	0	78	194K	8.2	0.0	14.5	18.7
22 - 24	12	0	33	42K	1.7	0.0	6.1	4.0
24 - 24	0	0	0	0K	0.0	0.0	0.0	0.0
TOTAL	700	6	536	1,033K	100.0	100.0	100.0	100.0

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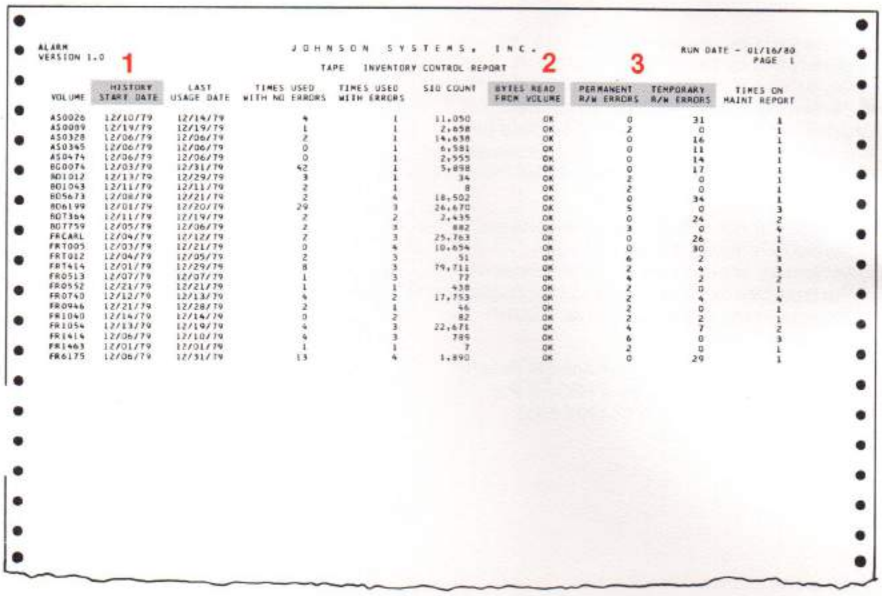
Inventory Control Report

This report provides a manageable quantity of output for use as a reference report. There is a page eject on changes in device type. A wide range of selection parameters may be used including volume serial number ranges or prefix ranges so that a list of volumes could be distributed to the owners of the volumes.

1 This report was limited to those volumes created in December.

2 This information is available for disc volumes only.

3 The number of errors shown indicates to the librarian or the user if the tape is experiencing read/write errors and should be replaced. Also note that only tape volumes that had errors are shown on this sample report.



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JOHNSON SYSTEMS, INC.
TAPE INVENTORY CONTROL REPORT **2** **3**

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VOLUME	HISTORY START DATE	LAST USAGE DATE	TIMES USED WITH NO ERRORS	TIMES USED WITH ERRORS	SIO COUNT	BYTES READ FROM VOLUME	PERMANENT R/W ERRORS	TEMPORARY R/W ERRORS	TIMES ON MAINT REPORT
AS0026	12/10/79	12/14/79	4	1	11,050	OK	0	31	1
AS0089	12/19/79	12/19/79	1	1	2,658	OK	2	0	1
AS0328	12/06/79	12/06/79	2	1	14,638	OK	0	16	1
AS0345	12/06/79	12/06/79	0	1	6,581	OK	0	11	1
AS0474	12/06/79	12/06/79	0	1	2,555	OK	0	14	1
BG0074	12/03/79	12/31/79	42	1	5,898	OK	0	17	1
BD1012	12/13/79	12/29/79	3	1	34	OK	2	0	1
BD1043	12/11/79	12/11/79	2	1	8	OK	2	0	1
BD5673	12/08/79	12/21/79	2	4	18,502	OK	0	34	1
BD6199	12/01/79	12/20/79	29	3	26,670	OK	5	0	3
BDT364	12/11/79	12/19/79	2	2	2,435	OK	0	24	2
BDT759	12/05/79	12/06/79	2	3	882	OK	3	0	4
FRCARL	12/04/79	12/12/79	2	3	25,763	OK	0	26	1
FRT005	12/03/79	12/21/79	0	4	10,654	OK	0	30	1
FRT012	12/04/79	12/05/79	2	3	51	OK	6	2	1
FRT414	12/01/79	12/29/79	8	3	79,711	OK	2	4	3
FR0513	12/07/79	12/07/79	1	3	77	OK	4	2	2
FR0552	12/21/79	12/21/79	1	1	438	OK	2	0	1
FR0740	12/12/79	12/13/79	4	2	17,753	OK	2	4	4
FR0946	12/21/79	12/28/79	2	1	46	OK	2	0	1
FR1040	12/14/79	12/14/79	0	2	82	OK	2	2	1
FR1054	12/13/79	12/19/79	4	3	22,671	OK	4	7	2
FR1414	12/06/79	12/10/79	4	3	789	OK	6	0	3
FR1463	12/01/79	12/01/79	1	1	7	OK	2	0	1
FR6175	12/06/79	12/31/79	13	4	1,890	OK	0	29	1

Media Audit Report

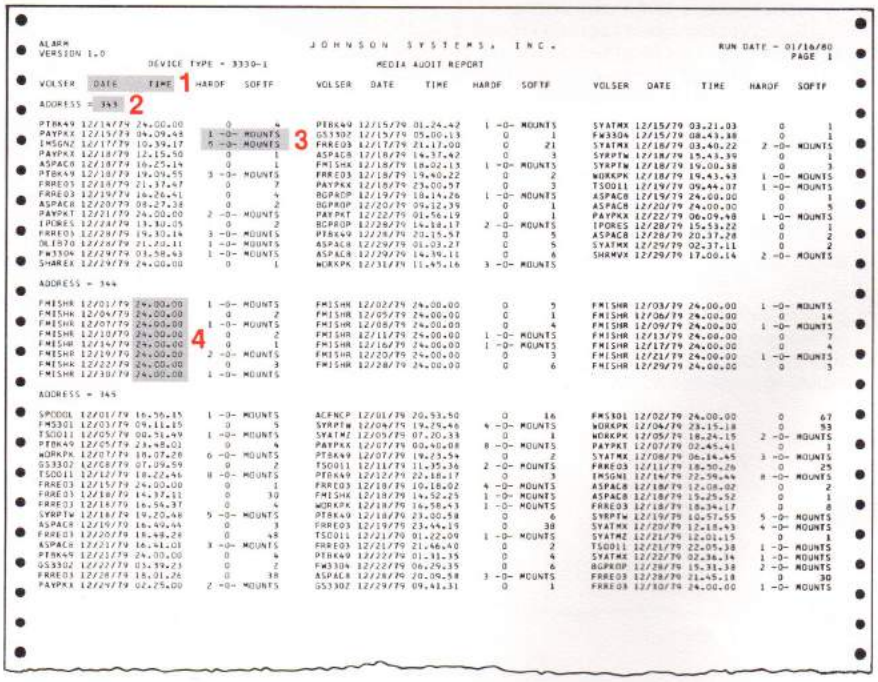
This report identifies media caused failures for mountable devices. Media caused failures may be inferred by noting failures occurring on one volume mounted on a drive where the preceding and succeeding volumes have few or no failures. A series of volumes experiencing failures indicates device failure — or that improper or inadequate cleaning was performed.

1 Report is sorted on date and time within device.

2 Every device with mountable volumes is displayed. This sample is for 3330-1 disks on devices 343, 344 and 345.

3 This notation shows the number of mounts that experienced no failures for that entry.

4 A series of 24.00 times indicates that volume FMISHR resided on 344 permanently.



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DEVICE TYPE = 3330-1

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VOLSER	DATE	TIME **1**	HARDF	SOFTF	VOLSER	DATE	TIME	HARDF	SOFTF	VOLSER	DATE	TIME	HARDF	SOFTF
ADDRESS = 343 **2**														
PTBK49	12/14/79	24.00.00	0	4	PTBK49	12/15/79	01.24.42	1	-0- MOUNTS	SYATMX	12/15/79	03.21.03	0	1
PAYPKX	12/15/79	04.09.43	1	-0- MOUNTS **3**	GS3302	12/15/79	05.00.13	0	1	FW3304	12/15/79	08.43.38	0	1
IMSGNZ	12/17/79	10.39.17	5	-0- MOUNTS	FRRE03	12/17/79	21.17.00	0	21	SYATMX	12/18/79	03.40.22	2	-0- MOUNTS
PAYPKX	12/18/79	12.15.50	0	1	ASPAC8	12/18/79	14.37.42	0	3	SYRPTW	12/18/79	15.43.39	0	1
ASPAC8	12/18/79	16.25.14	0	1	FMISHK	12/18/79	18.02.13	1	-0- MOUNTS	SYRPTW	12/18/79	19.00.38	0	3
PTBK49	12/18/79	19.09.55	3	-0- MOUNTS	FRRE03	12/18/79	19.40.22	0	2	WORKPK	12/18/79	19.43.43	1	-0- MOUNTS
FRRE03	12/18/79	21.37.47	0	7	PAYPKX	12/18/79	23.00.57	0	3	TSO011	12/19/79	09.44.07	1	-0- MOUNTS
FRRE03	12/19/79	16.26.41	0	4	BGPROP	12/19/79	18.14.26	1	-0- MOUNTS	ASPAC8	12/19/79	24.00.00	0	1
ASPAC8	12/20/79	08.27.38	0	2	BGPROP	12/20/79	09.12.39	0	1	ASPAC8	12/20/79	24.00.00	0	5
PAYPKT	12/21/79	24.00.00	2	-0- MOUNTS	PAYPKT	12/22/79	01.56.19	0	1	PAYPKX	12/22/79	06.09.48	1	-0- MOUNTS
IPORES	12/28/79	13.30.05	0	2	BGPROP	12/28/79	14.18.17	2	-0- MOUNTS	IPORES	12/28/79	15.53.22	0	1
FRRE03	12/28/79	19.30.14	3	-0- MOUNTS	PTBK49	12/28/79	20.15.57	0	5	ASPAC8	12/28/79	20.37.28	0	2
DLI870	12/28/79	21.20.11	1	-0- MOUNTS	ASPAC8	12/29/79	01.03.27	0	5	SYATMX	12/29/79	02.37.11	0	2
FW3304	12/29/79	03.58.43	1	-0- MOUNTS	ASPAC8	12/29/79	14.39.11	0	6	SHRMVX	12/29/79	17.00.14	2	-0- MOUNTS
SHAREX	12/29/79	24.00.00	0	1	WORKPK	12/31/79	11.45.16	3	-0- MOUNTS					
ADDRESS = 344														
FMISHR	12/01/79	24.00.00	1	-0- MOUNTS	FMISHR	12/02/79	24.00.00	0	5	FMISHR	12/03/79	24.00.00	1	-0- MOUNTS
FMISHR	12/04/79	24.00.00	0	2	FMISHR	12/05/79	24.00.00	0	1	FMISHR	12/06/79	24.00.00	0	14
FMISHR	12/07/79	24.00.00	1	-0- MOUNTS	FMISHR	12/08/79	24.00.00	0	4	FMISHR	12/09/79	24.00.00	1	-0- MOUNTS
FMISHR	12/10/79	24.00.00 **4**	0	2	FMISHR	12/11/79	24.00.00	1	-0- MOUNTS	FMISHR	12/13/79	24.00.00	0	7
FMISHR	12/14/79	24.00.00	0	1	FMISHR	12/16/79	24.00.00	1	-0- MOUNTS	FMISHR	12/17/79	24.00.00	0	4
FMISHR	12/19/79	24.00.00	2	-0- MOUNTS	FMISHR	12/20/79	24.00.00	0	3	FMISHR	12/21/79	24.00.00	1	-0- MOUNTS
FMISHR	12/22/79	24.00.00	0	3	FMISHR	12/28/79	24.00.00	0	6	FMISHR	12/29/79	24.00.00	0	3
FMISHR	12/30/79	24.00.00	1	-0- MOUNTS										
ADDRESS = 345														
SPOOOL	12/01/79	16.56.15	1	-0- MOUNTS	ACFNCP	12/01/79	20.53.50	0	16	FMS301	12/02/79	24.00.00	0	67
FMS301	12/03/79	09.11.15	0	5	SYRPTW	12/04/79	19.29.46	4	-0- MOUNTS	WORKPK	12/04/79	23.15.18	0	53
TSO011	12/05/79	00.51.49	1	-0- MOUNTS	SYATMZ	12/05/79	07.20.33	0	1	WORKPK	12/05/79	18.24.15	2	-0- MOUNTS
PTBK49	12/05/79	23.48.01	0	4	PAYPKX	12/07/79	00.40.08	8	-0- MOUNTS	PAYPKT	12/07/79	02.45.41	0	1
WORKPK	12/07/79	18.07.28	6	-0- MOUNTS	PTBK49	12/07/79	19.23.54	0	2	SYATMX	12/08/79	06.14.45	3	-0- MOUNTS
GS3302	12/08/79	07.09.59	0	2	TSO011	12/11/79	11.35.36	2	-0- MOUNTS	FRRE03	12/11/79	18.50.26	0	25
TSO011	12/12/79	18.22.46	8	-0- MOUNTS	PTBK49	12/12/79	22.18.17	0	3	IMSGN1	12/14/79	22.59.44	8	-0- MOUNTS
FRRE03	12/15/79	24.00.00	0	1	FRRE03	12/18/79	10.18.02	4	-0- MOUNTS	ASPAC8	12/18/79	12.08.02	0	2
FRRE03	12/18/79	14.37.11	0	30	FMISHK	12/18/79	14.52.25	1	-0- MOUNTS	ASPAC8	12/18/79	15.25.52	0	1
FRRE03	12/18/79	16.54.37	0	4	WORKPK	12/18/79	16.58.43	1	-0- MOUNTS	FRRE03	12/18/79	18.34.17	0	8
SYRPTW	12/18/79	19.20.48	5	-0- MOUNTS	PTBK49	12/18/79	23.00.58	0	6	SYRPTW	12/19/79	10.57.55	5	-0- MOUNTS
ASPAC8	12/19/79	16.49.44	0	3	FRRE03	12/19/79	23.44.19	0	38	SYATMX	12/20/79	12.18.43	4	-0- MOUNTS
FRRE03	12/20/79	18.48.28	0	48	TSO011	12/21/79	01.22.09	1	-0- MOUNTS	SYATMZ	12/21/79	12.01.15	0	1
ASPAC8	12/21/79	16.41.03	3	-0- MOUNTS	FRRE03	12/21/79	21.46.40	0	2	TSO011	12/21/79	22.05.38	1	-0- MOUNTS
PTBK49	12/21/79	24.00.00	0	4	PTBK49	12/22/79	01.31.35	0	4	SYATMX	12/22/79	02.36.34	1	-0- MOUNTS
GS3302	12/22/79	03.39.23	0	2	FW3304	12/22/79	06.29.35	0	6	BGPROP	12/28/79	15.31.38	2	-0- MOUNTS
FRRE03	12/28/79	18.01.26	0	38	ASPAC8	12/28/79	20.09.58	3	-0- MOUNTS	FRRE03	12/28/79	21.45.18	0	30
PAYPKX	12/29/79	02.25.00	2	-0- MOUNTS	GS3302	12/29/79	09.41.31	0	1	FRRE03	12/30/79	24.00.00	1	-0- MOUNTS

MANAGEMENT REPORTS

Most of these reports are normally produced on demand from the history files. In addition, each calendar quarter a summary of failure and usage is sent to JSI, who then produces user comparison reports and distributes them to those that participate. The management reports provide an overall picture of the installation's reliability problem, including the size of the problem and the cause from a historical perspective. The goal of this analysis is to improve system performance by reducing hardware and media failures. The management reports consist of:

- Error Summary Report By Device Type
- Device Error And Activity Summary Report
- Comparative Device Reliability Report
- Device Class Summary Report
- ALARM Users Comparison Report
- ALARM Users Comparison Detail Report
- ALARM Vendors Comparison Report

This report provides management an evaluation statement on the current month-to-date performance of each class of equipment in the installation. Mean-time-to-failure is used as the common denominator to make valid reliability evaluations. A comparison is shown in this example of the current performance to historical performance so that the trends are readily identified. This report is often run during the update cycle on a regular basis.

1 All device types described to the ALARM system are included.

2 All of the units for this equipment class are summarized. For example, there are 10 IBM 3420 mod 8 tape drives described in this entry.

3 A subjective evaluation determined by the relationship of current month data compared to historical data.

4 Options in this report make it possible to compare current month data against previous month.

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ERROR SUMMARY REPORT BY DEVICE TYPE FOR MONTH OF JANUARY VERSUS HISTORICAL.

APPROXIMATE HOURS OF OPERATION FOR JANUARY IS 549. HISTORICAL HOURS OF OPERATION IS 17,976.

HOURS OF OPERATION PER DEVICE PER ERROR

DEVICE TYPE	MDL NUM	VENDOR	NMBR UNIT	JANUARY: UNIT HOURS OF OPERATN	JANUARY: PERMANENT ERRORS	JANUARY: TEMPORARY ERRORS	JANUARY: MEAN TIME TO PERM	JANUARY: EVAL	JANUARY: MEAN TIME TO TEMP	JANUARY: EVAL	HISTORICAL: MEAN TIME TO PERM	HISTORICAL: MEAN TIME TO TEMP
2540R	00	IBM	1	549	0	16	INFINITE	EXCL	34.31	BAD	1,634.18	90.78
2540P	00	IBM	1	549	0	10	INFINITE	EXCL	54.90	BAD	999.93	319.12
1403	00	IBM	2	1,097	8	2,202	137.12	POOR	0.49	EXCL	223.91	4.02
3211	00	XEROX	1	458	0	0	INFINITE	EXCL	INFINITE	EXCL	113.12	INFINITE
3800	00	IBM	1	549	20	546	27.45	POOR	1.00	POOR	44.09	1.71
3066	00	AMDAHL	2	880	1	0	880.00	GOOD	INFINITE	EXCL	721.88	INFINITE
3277	00	IBM	26	14,267	62	58	230.11	POOR	245.98	BAD	253.40	929.16
3286	00	IBM	4	2,195	0	7	INFINITE	EXCL	313.57	BAD	1,057.04	1,748.19
3340	00	IBM	8	4,390	0	348	INFINITE	EXCL	12.61	BAD	3,650.25	189.13
3350	00	IBM	18	9,877	0	34	INFINITE	EXCL	290.50	EXCL	4,474.86	151.03
3330-1	00	ITEL	32	17,559	2	710	8,779.50	EXCL	24.73	EXCL	843.11	4.88
2741	00	COMTEN	113	61,648	507	28	121.59	GOOD	2,201.71	BAD	101.14	9,124.25
TTY	00	COMTEN	37	20,161	112	0	180.00	POOR	INFINITE	EXCL	212.28	INFINITE
3270	00	COMTEN	42	23,047	196	7	117.58	EXCL	3,292.42	EXCL	53.20	1,881.19
2400	00	IBM	3	1,646	0	0	INFINITE	EXCL	INFINITE	EXCL	1,002.20	34.16
3420	07	IBM	2	1,097	4	252	274.25	AVG	4.35	POOR	269.42	7.49
3420	08	IBM	10	5,487	36	12,206	152.41	GOOD	0.44	POOR	138.25	0.88
C0470	00	AMDAHL	2	899	1	19	899.00	POOR	47.31	EXCL	1,06[illegible].38	30.78
CI2860	00	AMDAHL	6	2,832	0	0	INFINITE	EXCL	INFINITE	EXCL	1,885.51	INFINITE
CI2870	00	AMDAHL	4	1,990	0	1	INFINITE	EXCL	1,990.00	EXCL	1,747.39	980.24
CI2880	00	AMDAHL	16	7,269	0	1	INFINITE	EXCL	INFINITE	EXCL	76,409.00	13,892.54
CU	00	AMDAHL	2	901	0	1	INFINITE	EXCL	INFINITE	EXCL	INFINITE	1,435.38
CU	00	COMTEN	30	16,187	0	1	INFINITE	EXCL	INFINITE	EXCL	INFINITE	4,332.57
CU	00	IBM	20	9,954	0	46	INFINITE	EXCL	216.39	POOR	24,021.16	431.51
CU	00	ITEL	4	2,057	0	1	INFINITE	EXCL	2,057.00	EXCL	8,591.20	77.53
CU	00	XEROX	1	480	0	0	INFINITE	EXCL	INFINITE	EXCL	INFINITE	INFINITE
CU	07	IBM	1	549	0	0	INFINITE	EXCL	INFINITE	EXCL	6,784.00	INFINITE
CP470	00	AMDAHL	2	901	0	1	INFINITE	EXCL	901.00	EXCL	467.31	342.14

This report summarizes permanent errors, temporary errors, and I/O activity for each of four consecutive months from the current month backward. It can be produced for each class of each vendor's equipment and provides a trend analysis at this level. The data provides management with a good overview of reliability, if it is getting better or worse, and shows how reliability relates to activity.

1 Report is for any class of equipment.

2 Although activity was down in December, failures increased.

3 Reports can optionally report I/O to failure instead of MTTF.

4 Problems in December were solved and January is the best of the four months.

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DEVICE ERROR AND ACTIVITY SUMMARY REPORT

DEVICE TYPE = 3330-1   MODEL = 00

NUMBER DEVICES = 32

HOURS OF OPERATION PER DEVICE PER ERROR

VENDOR = ITEL	PERMANENT ERRORS	TEMPORARY ERRORS	INPUT-OUTPUT (I/O) COUNT	HOURS PER TEMP ERROR	HOURS PER PERM ERROR	VOLUME USES (MOUNTS)	BYTES READ FROM DEVICE
JANUARY AVERAGE HOURS OF OPERATION PER DEVICE = 691							
TOTAL	2	710	22,609,685	N/A	N/A	322	176,580M
HIGH DEVICE	1	232	3,797,804	INFINITE	INFINITE	69	22,845M
LOW DEVICE	0	0	16,491	2	549	1	447M
AVERAGE PER DEVC	0	22	706,553	25	8,784	10	5,518M
DECEMBER AVERAGE HOURS OF OPERATION PER DEVICE = 647							
TOTAL	7	3,624	26,090,852	N/A	N/A	456	203,098M
HIGH DEVICE	1	2,953	3,540,640	INFINITE	INFINITE	144	24,336M
LOW DEVICE	0	0	19,480	0	647	0	123M
AVERAGE PER DEVC	0	113	815,339	6	2,958	14	6,347M
NOVEMBER AVERAGE HOURS OF OPERATION PER DEVICE = 688							
TOTAL	4	1,403	26,537,214	N/A	N/A	436	224,176M
HIGH DEVICE	1	712	4,146,565	INFINITE	INFINITE	92	28,021M
LOW DEVICE	0	0	25,632	1	688	0	356M
AVERAGE PER DEVC			879,288	12	5,504	14	7,006M
OCTOBER AVERAGE HOURS OF OPERATION PER DEVICE = 694							
TOTAL	4	1,193	33,431,143	N/A	N/A	408	255,750M
HIGH DEVICE	2	217	4,418,333	INFINITE	INFINITE	96	28,978M
LOW DEVICE	0	0	28,443	3	347	0	215M
AVERAGE PER DEVC	0	37	1,044,723	19	5,552	13	7,992M

Comparative Device Reliability Report

This report compares all devices in a given equipment class on I/O activity and error count. The most reliable device can be readily identified if a sufficient time period is specified. Each of the two graphs are separate entities. The device with the highest number of selected errors is graphed with a full line of asterisks, and errors for all other devices are graphed to scale.

1 The device with the worst problem was little used.

2 The device used the most had no permanent errors.

3 Any of the errors described on the Error Definition Statements can be chosen to be reported.

4 Total number of errors in the period is displayed.

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COMPARATIVE DEVICE RELIABILITY REPORT

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DEVICE TYPE = 3330-1, NUMBER REPORTING DEVICES = 32

3 NOTE ** THE LESS RELIABLE EQUIPMENT HAVE THE LONGER LINES

..........ERROR DATA..........

UNIT ADDR	UNIT VENDOR	NUMBR VOLS	I/O ACTIVITY + RANK WHERE HI IO=HI RNK			ERROR1 = PERM R/W ERRORS COUNT	RNK	DISTRIBUTION (WORST= 1 ERRS) ......25......50......75.....100	ERROR2 = TEMP R/W ERRORS COUNT	RNK	DISTRIBUTION (WORST= 232 ERRS) ......25......50......75.....100
250	ITEL	11	1,070K	24		0	1		26	16	****
251	ITEL	1	96K	8		0	1		45	19	*******
252	ITEL	3	79K	6	1	1	2	********************************	232	22	********************************
253	ITEL	1	93K	7		0	1		5	5	
254	ITEL	1	49K	3		0	1		8	7	*
255	ITEL	1	40K	2		0	1		20	13	***
256	ITEL	3	121K	9		0	1		6	6	
257	ITEL	69	312K	14		1	2	********************************	24	15	****
258	ITEL	1	51K	4		0	1		1	2	
259	ITEL	1	239K	12		0	1		1	2	
25A	ITEL	1	1,201K	28		0	1		1	2	
25B	ITEL	1	1,007K	23		0	1		75	21	************
25C	ITEL	1	2,596K	31		0	1		22	14	****
25D	ITEL	1	1,115K	27		0	1		1	2	
25E	ITEL	51	402K	18		0	1		12	9	*
25F	ITEL	63	368K	16		0	1		34	17	*****
370	ITEL	1	1,074K	25		0	1		38	18	******
371	ITEL	1	1,286K	29		0	1		47	20	*******
372	ITEL	1	236K	11		0	1		11	8	*
373	ITEL	1	122K	10		0	1		1	2	
374	ITEL	1	16K	1		0	1		6	6	
375	ITEL	1	535K	20		0	1		0	1	
376	ITEL	1	370K	17		0	1		1	2	
377	ITEL	64	73K	5		0	1		12	9	*
378	ITEL	1	1,078K	26		0	1		18	12	***
379	ITEL	1	515K	19		0	1		0	1	
37A	ITEL	1	351K	15		0	1		4	4	
37B	ITEL	1	2,168K	30		0	1		1	2	
37C	ITEL	1	3,798K	32	2	0	1		14	10	***
37D	ITEL	1	890K	21		0	1		2	3	
37E	ITEL	7	964K	22		0	1		28	16	****
37F	ITEL	48	295K	13		0	1		16	11	***

*** SUMMARY BY VENDOR ***

VENDOR	UNITS	ACCESSES	ERROR1	ERROR2	
ITEL	32	22,410	2	710	4
			PERM R/W ERRORS	TEMP R/W ERRORS	

Device Class Summary Report

This report provides total information on all error types summarized at the device class level for each vendor. Management can use this information to investigate the relationship between one type of error with another, to give maintenance personnel a way to monitor rare and unexpected types of errors that frequently could be overlooked, and to provide a means of finding out why different vendor's plug-compatible equipment is behaving differently in an identical environment using the same media.

1 All error patterns are listed.

2 Mid-term data for last four months is included.

3 Too small to measure on a per unit basis.

4 This error never has occurred.

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DEVICE CLASS SUMMARY REPORT

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DEVICE TYPE = 3330-1, VENDOR = ITEL , 32 UNITS, 724 AVE ACTIVITY DAYS WITHIN 09/01/77 01/31/80

NO	MAINT CODE	ERROR DESCRIPTION 1	TOTAL ERRORS	24-HR. AVE ERRORS	24-HR. AVE ERRORS/UNIT	AVERAGE IO PER ERROR(K)	AVERAGE HRS TO FAILURE	
0	I00	LOGREC RECORD COUNT	582,925	805.14	25.16	1	.95	
1	A01	TEMP R/W ERRORS	113,818	157.20	4.91	7	4.88	
2	A02	PERM R/W ERRORS	660	.91	.02	1,228	843.11	
3	I03	UNIT CHECK REC COUNT	23,341	32.23	1.00	34	23.84	
4	A04	BUS OUT CHECK	4	.00	.00	202,651	139,113.50	
5	A05	EQUIPMENT CHECK	17,529	24.21	.75	46	31.74	
6	A06	DATA CHECK	1,962	2.70	3.08	413	283.61	
7	A07	CHANNEL DATA CHECK	27	.03	.00	36,845	25,293.36	
8	A08	CHANNEL CONTROL CHK	38	.05	.00	21,331	14,643.52	
9	A09	INTERFACE CONTROL CK	52	.07	.00	15,588	10,701.03	
10	I10	RESERVED	0	.00	.00	810,606	556,454.00	
11	A11	SWAP ACTIVITY	225	.31	.00	3,602	2,473.12	
12	I12	INTERVENTION RECRD.	0	.00	.00	810,606	556,454.00	4
13	I13	COMAND REJECT	0	.00	.00	810,606	556,454.00	4
14	A14	TEMP READ ERRORS	2 154,060	212.79	6.64	5	3.61	

TEMP R/W ERRORS (4 MONTHS)	TOTAL ERRORS	24-HR. AVE ERRORS	24-HR. AVE ERRORS/UNIT	AVERAGE IO PER ERROR(K)	AVERAGE HRS TO FAILURE
FOR MONTH ENDING 01/16/80	710	32.27	.96	32	24.73
FOR MONTH ENDING 12/31/79	3,624	139.38	4.19	7	5.71
FOR MONTH ENDING 11/30/79	1,803	64.39	1.96	15	12.20
FOR MONTH ENDING 10/31/79	1,193	42.60	1.28	28	18.61
AVERAGE OVER FOUR MONTHS ******				15	11.25

PERM R/W ERRORS (4 MONTHS)	TOTAL ERRORS	24-HR. AVE ERRORS	24-HR. AVE ERRORS/UNIT	AVERAGE IO PER ERROR(K)	AVERAGE HRS TO FAILURE
FOR MONTH ENDING 01/15/80	2	.09	.00 3	11,305	8,779.50
FOR MONTH ENDING 12/31/79	7	.26	.00	3,727	2,958.42
FOR MONTH ENDING 11/30/79	4	.14	.00	6,634	5,500.50
FOR MONTH ENDING 10/31/79	4	.14	.00	8,358	5,552.25
AVERAGE OVER FOUR MONTHS ******				6,392	4,851.70

Alarm Users Comparison Report

This report is produced by JSI every calendar quarter from the data supplied by each user of ALARM. This report imparts a view to each user of his performance within his vendor group and compared to users of other vendor's equipment. The report ranks users (best to worst) within each vendor group, and displays each vendors' reliability averages for permanent and temporary errors.

1 Actual vendor names are shown in distributed reports.

2 Each graph is scaled so that the best user is shown with asterisks or periods across the width of the graph.

3 The best!

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                                         ALARM USERS COMPARISON REPORT
DEVICE TYPE = 3330  ,  MODEL = 00                                                               4TH QUARTER 1979

                      ------------PERMANENT ERRORS------------          ------------TEMPORARY ERRORS------------
USERS UNITS VENDOR    AVERAGE SEEKS          MEAN TIME                  AVERAGE SEEKS          MEAN TIME
                        PER ERROR            TO FAILURE                   PER ERROR            TO FAILURE

   2     20   AA   1      283,070               716.7                       5,332                 13.5
  18    549   BB        1,272,484             2,138.1                       5,648                  9.4
   6    331   CC        1,120,810             1,777.9                       1,845                  2.9
   3     34   DD        1,003,275             2,718.0                         697                  1.8

 USER  UNIT RNK  SCALE =  3,191.1 2 RNK  SCALE =  1,715.2     RNK  SCALE =       2.3     RNK  SCALE =     111.3
CPU-ID CNT      .0K             76.5K  290.0            41,456.0    .0K                .0K   1.2               2,673.0
                ------+------+------+   ------+------+------+-----  ------+------+------+    ------+------+------+
VENDOR AA
XXXXXX   16   2 *                      2 .                        2 *                      1 .
XXXXXX    4   1 *                      1 .                        1 ****                   2 .

VENDOR BB
XXXXXX   10  14 *                     18 .                       13 *                     17 .
XXXXXX    2  16 *                     11 *                        8 ******                 1 ......................+
XXXXXX    4  10 *                      9 ..                       7 *******                7 .
XXXXXX   16   3 **                     5 ...                      1 ***********************. 8 .
XXXXXX   22   9 *                     10 .                        6 *********              9 .
XXXXXX   37  17 *                     16 .                       14 *                      3 ..
XXXXXX   46   4 *                      3 ....                    15 *                     16 .
XXXXXX   35  11 *                  3   7 ..                       -                       18 .
XXXXXX  114   6 *                      2 ....                     4 ************           4 .
XXXXXX   16   1 ***********************+ 1 ......................* 10 ****                15 .
XXXXXX    8   7 *                     13 .                        9 ******                14 .
XXXXXX    4  13 *                     15 .                       12 *                     12 .
XXXXXX   15   2 ******                 4 ...                      2 ******************    13 .
XXXXXX   58   5 *                      6 ..                       3 *****************      5 .
XXXXXX   68  12 *                     12 .                       11 ***                   11 .
XXXXXX   73   8 *                      8 ..                       5 ************           6 .
XXXXXX    3   -                       17 .                        -                        2 ..........
XXXXXX   18  15 *                     14 .                       16 *                     10 .
```

Alarm Users Comparison Detail Report

This report is part of the JSI quarterly comparison series. It provides the backup data for the graphs above. It displays activity and reliability data for the same device type at each participating location. It is primarily used by the DP Manager, to compare his performance for the same equipment with other sites. From this comparison, he is able to ascertain if his equipment is up to industry standards.

1 A separate report for each device type.

2 Actual vendor and CPU-ID is shown for the quarterly reports.

3 Since there were no permanent errors, hours per permanent error is set at the total hours in operation.

ALARM   J O H N S O N   S Y S T E M S ,   I N C .   RUN DATE - 01/24/80
VERSION 1.0   PAGE 1
ALARM USERS COMPARISON DETAIL REPORT
DEVICE TYPE = 3330 , MODEL = 00 1   4TH QUARTER 1979

USER CPU-ID	UNITS	TEMPORARY ERRORS	PERMANENT ERRORS	NUMBER OF SEEKS (K)	HOURS	HOURS PER TEMP FAILS	HOURS PER PERM FAILS	SEEKS PER TEMP FAILS	SEEKS PER PERM FAILS
XXXXXX 2	16	2,003	54	6,890	35,593	17.76	659.12	3	127
XXXXXX	4	1,023	3	9,245	5,259	5.14	1,753.00	9	3,081
VENDOR AA	20	3,026	57	16,135	40,852	13.50	716.70	5,332	283,070
XXXXXX	10	5,176	84	11,195	24,358	4.70	289.97	2	133
XXXXXX	2	1	0	14	2,673	2,673.00	2,673.00	14	14
XXXXXX	4	74	1	1,245	3,667	49.55	3,667.00	16	1,245
XXXXXX	16	654	6	35,316	29,536	45.16	4,922.66	54	5,886
XXXXXX	22	568	6	12,492	16,969	29.87	2,828.16	21	2,082
XXXXXX	37	345	59	707	65,239	189.09	1,105.74	2	11
XXXXXX	46	7,383	5	19,737	36,185	4.89	7,237.00	2	3,947
XXXXXX	35	34,817	16	17,837	64,612	1.85	4,038.25	0	1,114
XXXXXX	114	1,474	16	42,211	121,231	82.24	7,576.93	28	2,638
XXXXXX	16	7,665	0	76,587	41,456	5.40	41,456.00 3	9	76,587
XXXXXX	8	1,075	6	15,152	11,192	10.41	1,865.33	14	2,525
XXXXXX	4	522	7	1,677	8,341	15.97	1,191.57	3	239
XXXXXX	15	1,615	4	71,351	20,048	12.41	5,012.00	44	17,837
XXXXXX	58	460	7	19,042	30,453	66.20	4,350.42	41	2,720
XXXXXX	68	6,409	55	50,326	112,587	17.56	2,047.03	7	915
XXXXXX	73	791	10	21,479	39,776	50.28	3,977.60	27	2,147
XXXXXX	3	3	3	0	1,155	1,155.00	385.00	0	2,147
XXXXXX	18	1,701	29	3,192	41,908	24.63	1,445.10	1	110
VENDOR BB	549	70,735	314	399,560	671,346	9.49	2,138.17	5,648	1,272,484
XXXXXX	32	33,154	22	21,718	77,951	2.33	3,543.22	0	987
XXXXXX	77	55,434	117	164,528	158,938	2.86	1,358.44	2	1,406
XXXXXX	8	5	3	0	10,647	2,129.40	3,549.00	0	0
XXXXXX	86	127,515	138	163,241	152,405	1.19	1,104.38	1	1,182
XXXXXX	32	6,839	67	12,694	56,847	8.31	848.46	1	189
XXXXXX	96	13,732	43	74,935	236,628	17.23	5,502.97	5	1,742
VENDOR CC	331	236,883	390	437,116	693,416	2.92	1,777.98	1,845	1,120,810
XXXXXX	2	1,226	0	489	3,057	2.49	3,057.00	0	489
XXXXXX	4	2,564	18	1,675	10,576	4.12	587.55	0	93
XXXXXX	28	37,941	11	26,931	65,191	1.71	5,926.45	0	2,448
VENDOR DD	34	41,731	29	29,095	78,824	1.88	2,718.06	697	1,003,275

Alarm Vendors Comparison Report

This report is the last of the JSI quarterly comparison series. It provides a summary of the data shown in reports above. It is primarily used to compare plug-compatible equipment for the various vendors at a glance.

1 Same report provided for other devices.

2 The most reliable device in terms of MTTF, but not in terms of seeks-to-failure.

3 An amazing difference in reliability for the five vendors!

ALARM   J O H N S O N   S Y S T E M S ,   I N C .   RUN DATE - 01/24/80
VERSION 1.0   PAGE 1
ALARM VENDORS COMPARISON REPORT
4TH QUARTER 1979

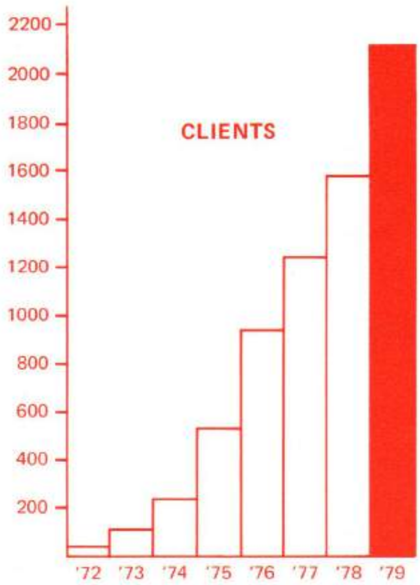
				PERMANENT ERRORS		TEMPORARY ERRORS	
DEVICE TYPE 1	USER CNT	UNITS	VENDOR	AVERAGE SEEKS PER ERROR	MEAN TIME TO FAILURE	AVERAGE SEEKS PER ERROR	MEAN TIME TO FAILURE
3330	2	20	AA	283,070	716.7	5,332	13.5
3330	18	549	BB	1,272,484	2,138.1	5,648	9.4
3330	6	331	CC	1,120,810	1,777.9	1,845	2.9
3330	3	34	DD	1,003,275	2,718.0 2	697	1.8
3350	1	4	AA	1,295,000	4,955.0	4,375	16.7
3350	24	583	BB	7,290,115	6,477.1	5,665	5.0
3350	3	72	CC	1,179,805	1,310.4	22,296	24.7
3350	10	655	DD	5,434,149	5,420.5	4,006	3.9
3330-1	1	28	AA	4,680,269	1,417.0	8,065	2.4
3330-1	20	830	BB	4,056,310	3,626.3	7,552	6.7
3330-1	6	234	CC	1,464,931	2,026.9 3	3,425	3.5
3330-1	7	332	DD	6,215,167	6,175.4	1,727	1.7
3330-1	1	6	EE	6,176,300	13,174.0	18,772	40.0

24 ABOUT JOHNSON SYSTEMS

Johnson Systems, Inc., is an international software company headquartered in McLean, Virginia, a suburb of Washington, DC with offices in Dallas, London and Düsseldorf and representatives worldwide. JSI specializes in performance related data center management software products.

Founded in 1971, JSI began by providing performance services to data center managers concerned about the efficiency of their computer resources. Based on this first-hand experience, JSI designed its first product, the Job Accounting Report System, now known worldwide as JARS. The first version of JARS, developed for DOS users, was installed in 1972. The OS version followed in 1973, and JSI was on its way to a goal of "providing complete data center accountability."

As the chart shows, now more than 2,000 Johnson Systems' job accounting packages have been installed around the world. JARS is the most widely used package of its kind, setting the standard against which all other job accounting packages are measured.



Meeting the data center manager's needs has been JSI's commitment from the beginning. To this end JSI personnel stay closely involved with data centers of all sizes and configurations. Recently, JSI installed inhouse twin 4331 CPU's dedicated to product development and customer support, one of the first data centers in the world to run this configuration.

Under the JSI theme of commitment, TSO support was introduced in 1974, POWER/VS support in 1975, graphic reporting capability in 1976, CICS/VS support in 1977, MVS and VM support in 1978, and DOS/VSE and IMS/VS support in 1979. Current versions of OS and DOS systems reflect JSI's concern to stay on the leading edge of full data center accountability.

In 1977, Johnson Systems introduced UMAX, the CICS/VS Utilization Monitor and Chargeback System, designed to provide data processing managers a tool with which to make effective analyses of CICS/VS acitivities. Data provided by UMAX yields a thorough picture of CICS/VS system accountability. UMAX measures CICS/VS user productivity, monitors the CICS/VS environment, evaluates software efficiency, and provides data for equitable customer billing and cost distribution.

APEX, Johnson Systems' Automated Planning and Execution Control System, was designed and tested by a select users group from the ground up. It completely automates the control of a data center's production workload. Released in 1977, APEX is the most powerful new concept for data center management since the introduction of the Operating System.

In 1980, Johnson Systems introduced ALARM, a Hardware Reliability Measurement System with which a user can pinpoint hardware and media reliability problems. ALARM permits the DP manager to control vendor maintenance, enhance hardware reliability, and maximize his system's performance.